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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
SPECIFICATION

MICROWAVE LANDING SYSTEM GROUND SYSTEM
TURNKEY FACILITY ESTABLISHMENT

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

SPECIFICATION

MICROWAVE LANDING SYSTEM GROUND EQUIPMENT

Turnkey Facility Establishment

NOTE: This is the second of 2 Parts in the FAA Specification on Microwave Landing System Ground System. Each Part carries the basic number FAA-E-2721 plus a suffix number that identifies the individual Part. The four Parts of the MLS specification are:

FAA-E-2721B	MICROWAVE LANDING SYSTEM (MLS) System Specification.
*FAA-E-2721/15	MICROWAVE LANDING SYSTEM GROUND EQUIPMENT, Turnkey Facility Establishment.

*Asterisk identified this specification.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

List of Tables

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

SPECIFICATION

MICROWAVE LANDING SYSTEM EQUIPMENT

TURNKEY FACILITY ESTABLISHMENT

Section 1

General Requirements

*Note: This is Section 1 of three Sections in FAA-E-2721/15, Microwave Landing System Equipment, Turnkey Facility Establishment.)

Listing of Sections

5-1-1 SCOPE.- Section 1 contains requirements of a general nature which are applicable alone, or in conjunction with other Parts of this specification, for the Turnkey Establishment of Microwave Landing System (MLS).

5-1-2 APPLICABLE DOCUMENTS

5-1-2.1 FAA Publications.- The following FAA publications, of the issue specified in the invitation for bids or request for proposals, form a part of this specification and are applicable to the extent specified herein:

FAR, Part 77, Subpart C Objects Affecting Navigable Airspace
FAA Handbook 8260.3B United States Standard for Terminal Instrument Procedures (TERPS)
FAA-E-2721B Microwave Landing System (MLS) System Specification
FAA-C-2454 Facility Site Preparation
FAA-G-2100 Electronic Equipment, General Requirements
DOT/FAA/PM-86/18 Siting Criteria for Microwave Landing System (MLS)
FAA Notice 8260.49 Civil Utilization of Time
Reference Scanning Beam MLS for Approach Angles of 3 degrees and Above
FAA Order 2500.36 Application of Reimbursable Flight Hour Rates
FAA Order 6750.36 Site Survey Selection and Engineering Documentation for Instrument Landing Systems and Ancillary Aids
FAA Order 3900.19 Occupational Safety and Health
FAA Order 1050.1 Policies and Procedures for Considering Environmental Impact
FAA-STD-002 Engineering Drawings
FAA-STD-019 Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities
FAA-STD-022 Microwave Landing System (MLS), Interoperability and Performance Requirements
FAA-STD-023 Microfilming of Engineering and Electrical Drawings
Advisory Circular 150/5370-2 Operational Safety on Airports During Construction
Advisory Circular 150/5300-4 Utility Airports - Air Access to National Transportation
Advisory Circular 150/5300-12 Airport Design Standards - Transport Airports

(Copies of FAA specifications and other publications may be obtained from the Contracting Officer in the office issuing the invitation for bids or request for proposals. Requests should fully identify material desired, such as specification amendments. Requests should cite the invitation for bids, request for proposals, or the contract involved, or other use to be made of the requested material.)

5-1-3 GENERAL REQUIREMENTS

5-1-3.1 Equipment and Services to be Furnished by the Contractor.- The Contractor shall provide all equipment, materials, and personnel services for Turnkey Facility Establishment except for those furnished by the Government as specified in paragraphs 5-1-3.2 through 5-1-3.2.9. The "turnkey" concept charges the Contractor with all tasks necessary to provide Government selected airports with a Microwave Landing System.

5-1-3.1.1 Contractor's Site Engineering Report (CSER).- The Contractor shall provide a detailed engineering report for each place-name specified in the contract schedule in accordance with paragraph 5-1-3.5.4. A report covering the Contractor's findings and recommendations shall be submitted for Government review and approval, as specified in the contract. The Contractor shall not commence any site activities until the report is approved by the Government.

5-1-3.1.2. Collision Risk Model.- The Government will execute the Collision Risk Model (CRM) when the Government deems it applicable to the sites selected in the CSER. The CRM will be used as site selection approval criteria.

5-1-3.1.3 Site preparation and plant construction.- After approval by the Government of the Contractor's Site Engineering Report, (paragraph 5-1-3.1.1), the Contractor shall clear each site and perform all construction work necessary for the final installation of the electronic equipment. The land lines required for system synchronization and communications shall also be installed. The site preparation and plant construction shall be accomplished in accordance with Section 2 of this specification and the requirements of FAA-C-2454, but prior to construction start, the contractor shall conduct a pre-construction conference at the affected airport. The contractor shall discuss construction issues, such as disposal and access, with Government and airport representatives. Upon completion, acceptability of the site facilities shall be determined in accordance the Test Plan specified in paragraph 5-1-3.1.7.

5-1-3.1.4 Installation, tune-up, and preliminary checks.- The Contractor shall perform installation and tune-up of the electronic equipment including remote control and status equipment, and preliminary checks of the facility in accordance with Section 3 of this specification. After satisfactory completion of installation, tune-up, and preliminary checks, the Contractor shall perform a satisfactory preliminary flight check and then request a commissioning flight inspection by the Government in accordance with paragraph 5-3-3.9.

5-1-3.1.5 Electronic equipment.- The contractor shall provide the MLS ground system that meets the requirements of the equipment specification, FAA-E-2721B.

5-1-3.1.6 Test equipment.- All required initial tuning adjustments and maintenance procedures shall be performed using only the test equipment, (special and common), identified by the Contractor to the Government for this purpose. The use of any other test equipment shall not be allowed.

5-1-3.1.7 Standard Test Plans and Procedures. The Contractor shall prepare standard Turnkey Test Plans and Procedures to ensure that for each installation project all equipment is physically and functionally checked out and to demonstrate the adequacy of the installation. Information for this document will be obtained from such sources as specifications, relevant test documentation used in the development test program, and relevant technical documentation from any agency concerned with the installation testing.

The Contractor shall submit all of the test plans to the Government for approval prior to the scheduled commencement of site preparation and plant construction. Unless otherwise specified, all test procedures shall be submitted to the Government prior to the scheduled commencement of site preparation and plant construction. The test plans and procedures shall address, but not be limited to, the following tests.

5-1-3.1.7.1 Stability Tests. The Contractor shall prepare instructions for a stability test to verify overall system performance in the operational environment. During this test, the Contractor shall, as a minimum, monitor and record data, at least once during each 8-hour period, on the following items:

(a) Alarm/alert parameters.

(b) Maintenance parameters.

(c) Record of integrity alarms and secondary alerts.

(d) Record of maintenance warnings.

5-1-3.1.7.2 Stability Test Log. A columnar log entitled "Stability Test Log", which shall be used during the stability testing, shall be provided in the following format:

(a) Title (Stability Testing).

(b) Parameter monitored.

(c) Results Obtained. (A blank column shall be provided, allowing sufficient space to record all test results obtained related to the steps performed).

5-1-3.1.7.3 Preliminary Flight Inspection/Government Commissioning Flight Inspection. The contractor shall provide for the installation and inspection teams a listing of the logical sequence of action during the Preliminary Flight Inspection and the Government Commissioning Flight Inspection. These instructions shall identify and describe:

(a) Minimum equipment performance standards during the flight inspection (flight check).

(b) Equipment adjustments that will or may be required during the flight inspection (flight check).

(c) Equipment performance readings and recordings that must be documented during flight inspection (flight check).

(d) All computation normally required of ground personnel during the flight inspection (flight check).

(e) The flight check data format which is subject to Government approval prior to Preliminary Flight Inspection.

5-1-3.1.8 Environmental Impact Assessment.- The Contractor shall assess the Impact of each MLS installation according to FAA Order 1050.1 and provide a report as indicated in the FAA Order and the contract.

5-1-3.2 Government responsibilities

5-1-3.2.1 Airport and runway locations.- The Government will specify in the contract schedule the airport and runway locations where Microwave Landing Systems are to be installed, including the designated airport place names and runway identifications. Priorities for the establishment of the facilities will also be provided.

5-1-3.2.2 Transmission frequencies.- Transmission frequencies for each runway and each MLS station and transmitting equipment will be specified by the Government.

5-1-3.2.3 (Not used)

5-1-3.2.4 Remote monitoring and control.- The location of remote monitoring and control equipment shall be specified by the government for inclusion into the Contractor's Site Engineering Report.

5-1-3.2.5 Land acquisition.- All land acquisition that is required for establishment of the facility will be accomplished by the Government or the airport authority. The Contractor shall work closely with the Government during the selection of sites that are off the airport to insure that the selected sites are obtainable.

5-1-3.2.6 Right-of-way.- Acquisition of permanent right-of-way for access roads, power and telephone lines will be made by the Government. Licenses and leases of a permanent nature will be negotiated by the Government with the owner(s).

5-1-3.2.7 Airport data package.- For each facility place-name (and runway) identified in the contract schedule, the Government will furnish applicable airport information presently in government files to the Contractor. The drawings in this data package will be submitted in a reproducible form (1 copy); either aperature cards or, depending on size of the original drawings, either "D": or "E" size vellums, at the discretion of the particular Government regional office involved. Information which will be provided will normally include:

(1) An index which includes all drawing titles and numbers.

(2) The name, address, and phone number of an airport sponsor contact point.

(3) FAA Facilities General Layout Plan, (if available).

(4) Site drawing of existing or under construction FAA facilities along both sides of the proposed MLS runway, (e.g., RVR, VASI, AWOS, etc.).

(5) ATCT, TRACON, or FSS equipment room layouts, console layouts, and control panels (RCSU and RSU).

(6) Glide slope plot plan/vicinity sketch, (both ends of the proposed MLS runway, if applicable).

(7) Localizer plot plan/vicinity sketch, (both ends of the proposed MLS runway, if applicable).

(8) Approach light system drawings, (including extended centerline profiles for both ends of the proposed MLS runway, if applicable).

(9) Regional drawing title block.

(10) Minimum Glide Path and Approach Reference Datum Height.

5-1-3.2.8 Government Commissioning Flight Inspection (GCFI).- The Government Commissioning Flight Inspection of each system will be provided for and conducted by the Government.

5-1-3.3 System design, integration, and checkout constraints.- If the site preparation, plant construction, installation, and tune-up of the equipment are performed in an operational environment, Air Traffic Control activities and services shall have priority over all Contractor activities. There shall be no compromise for the safe and timely control of aircraft during this entire period. The turnkey Contractor shall provide his services in such a manner that avoids disruptions to Air Traffic Control facilities and conforms to the procedures considered essential by the Government for assuring safety in air traffic control. At MLS sites scheduled to be collocated with existing ILS facilities, the Contractor shall coordinate all construction and installation activities to minimize interruption to existing ILS service. Erection of all antennas, equipment enclosures, platforms and supporting structures shall be scheduled concurrently and coordinated with local and regional Airway Facilities personnel to coincide with availability of Government provided flight

inspection for the purpose of re-certifying existing ILS service, (Reference Advisory Circular AC No. 150/5370-2).

5-1-3.4 Contracting Officer's Representative (COR). The Government will designate individuals as the Contracting Officer's Representatives for the various phases of the MLS turnkey project. The representatives so designated shall be the points of contact for the Government in their assigned areas.

5-1-3.5 Contractor responsibilities

5-1-3.5.1 Site Survey

5-1-3.5.1.1 Pre-survey conference.- Prior to the start of the site survey and evaluation, the Contractor shall request a pre-survey conference with airport authorities and regional Government representatives. The purpose of this conference is to ensure that all requirements relating to the specific site are identified and included in the CSER as required. Any site peculiarities such as unusual weather, wind, temperature extremes, jet blast vulnerability, possible flooding, tidal flats (or zones), permafrost, etc., shall be identified. Sites that will require detailed soil investigation borings shall be proposed and addressed during the pre-survey conference. The Contractor shall prepare and submit, as part of the request for a pre-survey conference, a preliminary site selection analysis. The preliminary site selection analysis shall be based on the information contained on any available airport drawings, (paragraph 5-1-3.2.8), conversations and coordination with local airport personnel and site visits as necessary. The analysis shall compare a minimum of three (3) facility locations for each station of the MLS. The analysis shall contain a description of the three facility locations, a description of possible effects of planned construction on existing airport facilities, an economic analysis based upon preliminary estimates, effect of possible airport expansion on the proposed installation, a listing of the advantages and disadvantages of each facility location, a summary discussion of each facility location and a recommendation as to the optimum facility location.

5-1-3.5.1.2 Site survey and evaluation.- For locations specified in the contract schedule, the Contractor shall perform a site survey and evaluation to determine equipment and site locations for MLS installation and operation. The Contractor shall include in the CSER a recommended antenna configuration based on constraints identified during the site survey. The Contractor shall include in the CSER complete details of the recommended facility locations. The CSER shall also include a description of alternate locations discussed during the pre-survey conference, and the reason(s) for selecting the recommended location as opposed to the alternative locations. The Government furnished data packages (by regions) are furnished for preliminary siting purposes only. The data is not intended for the Contractors detailed engineering. The Contractor's engineering shall be based on the detail data gathered during the site survey.

5-1-3.5.1.3 Facility location.- Determine the location and geographic coordinates of the MLS equipment, including: Azimuth, Elevation, DME/P and monitoring equipment. The selection of each location shall be in accordance with TERPS, FAR Part 77C, DOT/FAA/PM-86/18, "Siting Criteria for Microwave Landing System (MLS)", AC No. 150/5300-4, and AC No. 150/5300-12. The Government shall be verbally notified immediately of any deviations which shall also be formally submitted to the Government for approval.

5-1-3.5.2 Plant survey.- The plant survey shall indicate recommended routing of primary power, telephone lines, (if required for remote monitoring), synchronization lines, and access roads to the various sites and determine trenching and ducting requirements.

5-1-3.5.3 Coordination.- The site survey shall require liaison with airport authorities and regional Government representatives to determine requirements. The CSER covering such items as any additional grading or land preparation, land and right-of-way acquisitions, power termination points, and the type of installation recommended shall be prepared with the cognizance and agreement of airport authorities and Government regional representatives. Coordination shall also be conducted with airport and Government regional representatives to obtain requirements and instructions for activities of the Contractor on the airport in matters relating to security, safety, insurance, and the movement of people and equipment, (Reference: Advisory Circular AC No. 150/5370-2). The Contractor shall be required to coordinate through the FAA Regional Office representative for the initial contact with the airport sponsor.

5-1-3.5.4 Detailed requirements of Contractor's Site Engineering Report (CSER).- As a result of data obtained from the site survey and evaluation, the Contractor shall submit for Government review and approval a detailed Contractor's Site Engineering Report (CSER) covering its findings and recommendations. The report shall include all essential tasks for site construction and equipment installation.

(a) All tasks shall comply with Sections 2 and 3 of this specification where applicable. The minimum information to be included in the report is as follows:

(1) Exact location details, including geographic coordinates, of equipment to be installed (Azimuth, Back Azimuth, Elevation, and DME/P). See Table II, "Survey Requirements." For MLS stations scheduled to be collocated with existing ILS stations, location details shall include the position and distances of all equipment to be installed relative to the position of existing ILS equipment. Additionally, a detailed analysis shall be included on possible adverse effects of the proposed installation on the existing ILS service.

Note: Following equipment installation the data supplied in compliance with Table II shall be updated.

(2) Exact locations and all details required for the acquisition and/or installation of power service, access roads, communication lines, synchronization lines, and remote control and status equipment.

(3) Grading, trenching, ducting and cabling details.

(4) Schedule for completion of the various turnkey tasks.

(5) Location and description of alternate facility locations investigated during the pre-survey conference together with a discussion of the reason(s) for not proceeding with them.

(6) Submission of all data pertinent to substantiation of conclusions used in the site selection process. Any tools used in the site selection process, such as computer programs, formulas and models, shall be approved by the Government and identified in the CSER.

(7) The Government will specify in the contract the MLS Equipment antenna configurations to be installed at each airport runway. The Contractor shall identify the most appropriate antenna configuration in the CSER based on the results of the site survey, sound engineering practices and operational considerations, and shall recommend changes to contractually specified antenna options. The MLS antenna configurations are specified in paragraph 3.2.1.1.14 and 3.2.1.2.13 of FAA-E-2721B. Each Azimuth Station shall include a Precision Distance Measuring Equipment (DME/P), as specified in FAA-E-2721B, unless otherwise specified in the contract.

(8) Determine initial requirements for OCI.

(b) Installation drawings and specifications shall be submitted with the CSER and shall define all siting geometry, foundation type size and depth, construction details, instructions, specifications, and materials and structures necessary to accomplish the installation. All drawings shall be prepared in accordance with FAA-STD-002. The site specific installation drawings shall be "D" size (22" x 34") and shall incorporate the regional title block in lieu of the Washington title block. These installation drawings shall follow the format and categories as specified in paragraph 5-1-3.5.5. The content of the drawings shall include as a minimum:

(1) Locations of Azimuth/DME walk-in equipment enclosure together with antennas, buried cable routing and monitoring devices and their associated cable locations.

(2) Locations of Elevation walk-in equipment enclosure together with antennas, buried cable routing and monitoring devices, and their associated cable locations.

(3) Locations of any Back Azimuth walk-in equipment enclosure together with antennas buried, cable routing and monitoring devices, and their associated cable locations.

(4) Locations of Remote Control and Status Units and Remote Status Units and their associated cable routings.

(5) Locations of Remote Monitoring Subsystem (RMS's) and their associated cable routings.

(6) Monitor and control circuits routing and cable requirements.

(7) Primary power installation, including transformer mountings, wiring substation details and buried cable routing and cable markers.

(8) Schematics and/or wiring diagrams of equipment interconnections not covered in other technical documents.

(c) The following soil data parameters shall be determined prior to completing the foundation design (based on data obtained at the local site):

(1) Ground water data.

(2) Ultimate vertical compression strength.

(3) Ultimate horizontal shear strength.

(4) Maximum safe soil strength with minimum safety factors as specified in FAA-E-2721B, paragraph 3.3.4.3.1.2.

(5) Maximum actual overturning moment, (based on hydrastatic soil conditions at the site), with minimum overturning safety factor as specified in FAA-E-2721B, paragraph 3.3.4.3.1.2.

5-1-3.5.5 "Red-lined" installation drawings.- The Contractor shall provide three "D" size sets of marked-up drawings which were included in the approved CSER, previously provided by the Government, using a red pencil, to show any changes resulting from the installation of his equipment. The marking shall include, but not be limited to, wiring diagrams, (including color coding), identification and terminal markings, electrical details, and equipment and system interconnections and terminations. All markings shall be legible and depicted in a manner that will enable the Government to verify corrections to the originals. The accuracy of the marked-up drawings shall be verified during the Joint Installation Inspection. Upon completion of the Joint Installation Inspection, one set of the marked-up drawings shall be delivered to the COR for forwarding to the cognizant Government regional office where they will be used to validate the originals. One set shall be delivered to the COR for retention at the site until the revised drawings are received from the Government regional office. The other set shall be delivered to the contracting officer or his COR.

5-1-3.5.5.1 Drawings for the CSER.- The Contractor shall provide 1 set of drawings, reduced from "D" size to "B" size with each copy of the CSER. These drawings fall into 3 different categories as specified in (a), (b), and (c) below.

(a) Site specific drawings:

The Contractor shall use the Government supplied drawings and data to generate new MLS site plan drawings. Cutting, pasting and microfilm drafting techniques may be used to generate these new drawings. This will result in an integrated drawing with information from several

drawings superimposed with new MLS site data. These drawings shall contain the appropriate regional title block and site adapted notes referencing the ILS, MALSR, or other drawing numbers used to produce them. Examples of Government airport drawings, which could be used to develop site specific drawings, include localizer, glide slope and RVR plot plans, and various types of ALS drawings.

(b) MLS standard drawings:

The Contractor shall prepare standard drawings that can be used for most MLS installations. Examples of standard drawings are platforms, fences, culverts, equipment shelters, antennas, and concrete pad details. These drawings shall contain the headquarters title block and be signed by the appropriate Government personnel. Copies of the appropriate standard drawings shall be submitted as a part of each CSER.

(c) Government facility drawings:

Government drawings of ATCT's and FSS's that show equipment rooms and console layouts fall into a third category. These drawings shall be updated by the Contractor to indicate the placement of MLS control and status equipment and its associated cabling. This third category also includes the facilities General Layout Plan. The Contractor shall update this plan to indicate the MLS equipment sites. All updates shall be made according to current drafting standards and practices, including completing of the revision block.

5-1-3.5.6 "As-Built" drawings. All site specific drawings, paragraph 5-1.3.5.4(b), except MLS standard drawings, which are submitted at the Government Acceptance Inspection shall be replaced with reproducible "D" size vellums of aperture cards in accordance with FAA-STD-023 at the Governments option and identified as 'As-Built' drawings, except the Mylar drawings submitted by the Government. The Government Mylar drawings shall be updated and returned as part of the As-Built package.

5-1-3.6 Review of Contractor's Site Engineering Report.- The Contractor's Site Engineering Report shall be submitted in eight copies to the addresses provided by the Government Contracting Officer or the COR, for review and approval. The Contractor shall not proceed with any site activity, (construction and installation), until the CSER Engineering Report has been approved by the Contracting Officer or his COR.

5-1-3.7 General Administrative and Support Services.- The Contractor shall be responsible for the performance of all administrative and support services necessary under the provisions of the contract.

5-1-3.7.1 Office facilities.- The Contractor shall furnish all office space, furniture, and supplies as required for his use. The location of this office shall be included in the Contractor's Site Engineering Report.

5-1-3.7.2 Miscellaneous services.- The services required for the movement of Contractor personnel, mail, and materials at each location shall be the

Contractor's responsibility. Storage and security of on-site materials shall be the responsibility of the Contractor. To the extent that suitable Government storage facilities are available on-site, they may be made available to the Contractor. It shall be the Contractor's responsibility to ascertain the availability of such facilities and request access thereto in the CSER.

5-1-3.8 Additional contractor submissions.- The Contractor shall submit for Government approval a general Installation Quality Control Plan/Test Procedure applicable to all turnkey installations; as a minimum, the Contractor shall submit a test report following installation completion.

5-1-4 QUALITY ASSURANCE PROVISIONS

5-1-4.1 General.- The Contractor shall provide and maintain a quality control system in accordance with contract requirements, and shall apply the quality assurance provisions as specified in Section 4 of FAA-G-2100. The Contractor shall also provide and maintain a software quality program in accordance with contract requirements. The objective of these quality control systems and programs shall include, but not be limited to, the validation of signal format, RF characteristics, accuracy and coverage requirements as detailed in this specification and in FAA-STD-022.

Each installation shall be tested in accordance with the test plans and procedures, reference paragraph 5-1-3.1.7. The following information shall be prepared for the acceptance team upon completing all installation testing on all MLS equipment installed at each location:

a. Data sheets showing the actual measurements made during the Site Inspection Tests, Stability Run, and Preliminary Flight Check, and the acceptance limits or criteria for each measurement.

b. A list of all items or parts used during installation testing.

c. A list of the MLS equipment installed and tested and Contractor furnished test equipment at each location, including all serial numbers and model numbers.

5-1-4.2 Acceptance data.- After acceptance of the installation, the data will be compiled into a report to record installation test results for each MLS system installed.

5-1-5 PREPARATION FOR DELIVERY

5-1-5.1 Not applicable

5-1-6 NOTES

5-1-6.1 None

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

SPECIFICATION

MICROWAVE LANDING SYSTEM EQUIPMENT
TURNKEY FACILITY ESTABLISHMENT

SECTION 2
SITE PREPARATION AND PLANT CONSTRUCTION

(Note: This is Section 2 of three Sections in FAA-E-2721/15, Microwave Landing System Equipment, Turnkey Facility Establishment.)

Listing of Sections

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5-2-1 SCOPE

5-2-1.1 Scope.- Section 2 is one of three sections of FAA-E-2721/15, Microwave Landing System Equipment, Turnkey Facility Establishment. Section 2 contains requirements applicable to the equipment, materials and personnel services for site preparation and plant construction. This section supplements the General Requirements contained in Section 1 of this specification.

5-2-2 APPLICABLE DOCUMENTS

5-2-2.1 FAA Documents.- The following FAA specifications, handbooks, orders, and drawings of the issues specified in the invitation for bids or request for proposals, form a part of this specification and are applicable as specified herein:

5-2-2.1.1 FAA documents, orders and drawings

- FAA-C-1217 Electrical Work, Interior
- FAA-C-1391 Installation and Splicing of Underground Cables
- FAA-C-2454 Facility Site Preparation
- FAA Order 6940.2 Access Road Cross Sections and Typical Drainage Details for FAA facilities
- FAA-STD-019 Lightning Protection, Grounding, Bonding, and Shielding Requirements For Facilities
- FAA-STD-020 Transient Protection, Grounding Bonding and Shielding Requirements for Equipment
- FAA-STD-022 Microwave Landing System, Interoperability and Performance Requirements
- D-5980-1 Access Road Cross Sections for FAA Facilities
- D-5980-2 Typical Drainage Details for FAA Access Roads
- FAA-E-2065 Fences
- D-5597 Chain Link Fence Details
- SO-D-1573-E15 Standard Terminal and Meter Pole
- FAA Order 3900.19 FAA Safety Order

5-2-2.2 Other publications.- The following publications of the issues in effect on the date of the invitation for bids or request for proposals form a part of this specification and are applicable to the extent specified herein.

- ANSI-C57.12.25 American National Standard Requirements for Pad-Mounted, Compartmental Type Self-Cooled Single Phase Distribution Transformers with Separable Insulated High Voltage Connectors: High-Voltage, 34500 GrdY/19920 Volts and Below; Low Voltage, 240/120 Volts; 167 kVA and Smaller.

. NFPA No. 70 National Electrical Code

. ACI-318 American Concrete Institute Standard Building Code Requirements for Reinforced Concrete

. National Climatic Data Center document "Extreme Frost Penetration Chart"

. ASTM A615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

. ACI-336.2 Suggested Design Procedures for Combined Footings and Mats

AASHO Specifications:

. M-36 Standard Specification for Corrugated Metal Culvert Pipe

5-2-2.3 Military and Federal Publications.- The following Military and Federal Publications of the issue in effect on the date of the Invitation for Bids or Requests for Proposal's, form a part of this specification and are applicable to the extent specified herein.

5-2-2.3.1 Federal Specification.- QQ-C-806 Culverts and Underdrains, Corrugated Iron or Steel, Zinc Coated (Information on obtaining copies of AASHO specifications may be obtained from the American Association of State Highway and Transportation Officials, 444 North Capital Street, N.W., Washington, D.C. 20001).

(Copies of these specifications and other applicable FAA specifications, handbooks, and drawings may be obtained from the Contracting Officer in the Federal Aviation Administration Office issuing the invitation for bids or request for proposals. Request should fully identify material desired, i.e., specification, handbook, and drawing numbers and dates. Requests should cite the invitation for bids, request for proposals, or the contract involved or other use to be made of the requested material.)

(Information on obtaining copies of the National Electrical Code may be obtained from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Massachusetts 02210)

5-2-3 GENERAL REQUIREMENTS

5-2-3.1 Equipment and services to be furnished by the contractor.- The Contractor shall provide all equipments, materials and personnel services for site preparation and plant construction in accordance with FAA-C-2454, "Facility Site Preparation", and FAA-STD-019, "Lightning Protection, Grounding, Bonding, and Shielding Requirements for Facilities," NEC and OSHA requirements.

5-2-3.2 Site clearing and grading.- The Contractor shall accomplish the clearing, grubbing, and grading required to prepare all sites for installation of the MLS subsystems, except work that has been identified as a responsibility of the Government or airport authority. Work shall be in accordance with the CSER and Section 2-1 of FAA-C-2454. The effort shall be limited to minor leveling and grading in the immediate area of the walk-in enclosures and providing proper drainage of the site. Minor leveling and grading as used herein is defined as the movement of up to 150 cubic yards of earth without the need for truck hauling or the hauling by truck and placement of up to 50 cubic yards of earth.

5-2-3.3 Earthwork.- All excavation, filling and backfilling shall be accomplished in accordance with the engineering report, construction drawings, and Section 2-2 of FAA-C-2454. Excavated material not suitable or required for backfilling shall be disposed of by the Contractor at a location arranged for by the Contractor, with the approval of the COR.

5-2-3.3.1 Rock Excavation.- Rock excavation shall consist of the excavation of boulders having a volume greater than 1/2 cubic yard, or the excavation of ledge rock which cannot be removed without blasting, chipping, wedging, or the use of rippers. Soft or decomposed rock which can be removed with a backhoe will not be considered under this item. For cable trenches, measurement for the purposes of payment shall be the length of the trench by a maximum width of 12 inches to the required depth. For pipe trenches, measurement for the purpose of payment shall be the length of the trench by a maximum width of 12 inches from either side of the pipe to the required depth. For foundations, measurement for the purposes of payment shall be a maximum of 12 inches greater than the length of the foundation by a maximum width of 12 inches greater than the width of the foundation, to the required depth. All excavation of rock shall include the removal and disposal of excavated material not suitable or required for backfilling; replacement with suitable backfill material and installation, including the furnishing of material for 3 inches of bedding material under cables, or 3/4 inches of crushed stone bedding material under pipe.

5-2-3.4 Concrete work.- All concrete structures/components shall be a minimum 3000 pounds per square inch concrete of portland cement, fine and coarse aggregate and air entrainment agent in accordance with Standard ACI-318, "American Concrete Institute Standard Building Code Requirements for Reinforced Concrete." The concrete shall have a maximum slump of 3 inches. Concrete reinforcement shall be deformed reinforcement steel conforming to ASTM A615, "Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement" or equal. All concrete foundations shall be formed to full depth. Construction of all concrete work shall conform to Part 3, "Construction Requirements", of ACI-318. The bottom of all foundations shall be carried to a minimum depth of 12 inches below the local frost depth, (as defined in a document that can be obtained from the National Climatic Data Center, Asheville, N.C., "Extreme Frost Penetration Chart" and contact the Corps of Engineers for the criteria of construction practices for Cold Regions:

U.S. Army Corps of Engineers, Cold Regions Research and Engineering Lab, 72 Lyme Road, Hanover, NH 03755), unless other approved methods are used to prevent frost heave of the foundations, such as pile foundations include findings in the CSER. Excavation deeper than the required depth shall be brought to the correct level with plain concrete, which shall be allowed to harden before the foundation concrete is placed. All foundation designs shall be site adapted by the Contractor as necessary to meet local soil conditions and the reactions resulting from the maximum dead and live loads the antenna must sustain. The top of the foundation shall be no higher than 1 1/2 inches above the top elevation of the ground in the immediate area of the structure. The top four edges of the foundation piers, pedestals, etc., which are above ground, shall be chamferred a minimum of one inch for the entire width of each face.

Except when local site conditions dictate other suitable types of foundation, the standard reinforced concrete foundation for both elevated and ground mounted structures shall be of the spread footing type design. In addition, all piers and pedestals of an elevated structure shall be anchored in a single spread footing to prevent differential settlement, heaving, or uplift associated with high wind loads. The foundation design shall be based on ACI publication title No. 336.2 of committee 436 "Suggested Design Procedure for Combined Footings and Mats." The foundation design shall be considered rigid based on the relative stiffness, ratio evaluation indicated in method ACI 336.2, "Suggested Design Procedures for Combined Footings and Mats." If required for stiffness, the pedestals shall be tied together with horizontal reinforced concrete grade beams or shear walls. For sites located in major earthquake areas, the foundation pedestals shall be connected with the horizontal grade beams and/or shear walls. The foundation designs shall be based on a complete and detailed soils investigation, including soil borings, laboratory analysis and report. The soils investigation shall be arranged by the Contractor, conducted and performed by a firm regularly engaged in soils investigations.

Base plates shall be used under support members for distribution of the compressive loads over a sufficient area of the concrete support pier or pedestal. The top of the pedestal or piers shall be left a minimum of 2 inches lower than the finished concrete elevation in order to allow for the proper alignment of the support members. Shrinkage compensating grout shall be used to grout-in the bases of the columns and other structures supported directly by the concrete foundation.

The concrete shall be cured by keeping the exposed surfaces moist for a minimum of 7 days. When high early strength concrete is used, this time may be reduced by one half. See paragraph 5.5, "Curing", of ACI-318. Other approved methods of curing the concrete may be used; see chapter 5 of ACI-318.

The removal of forms and shores for the concrete work shall conform to the recommended practices as stipulated in paragraph 6.2.of ACI-318. No loads shall be imposed on the concrete without insuring that the concrete has developed sufficient strength to support the loads without damage.

5-2-3.5 AZ, DME/P, EL, and Back AZ antenna support foundations.- The Contractor shall design and build the antenna support foundation based on local soils and the reaction resulting from the maximum dead and live loads the antenna must sustain. The design and materials for the foundations shall be as stipulated in paragraph 5-2-3.4 above.

5-2-3.6 AZ, DME/P, EL and Back AZ antenna installation.- At the option of the Contractor, any antennas or parts of the antenna may be installed as specified in the CSER.

5-2-3.7 Walk-in Enclosure.- The Contractor shall install the walk-in enclosures in accordance with the CSER.

5-2-3.7.1 Walkways.- The Contractor shall provide gravel walkways between the equipment enclosures and the field monitor antennas, and also between the Azimuth and DME/P equipment, as shown on the site engineering drawings. Walkways shall be a minimum of three (3) feet wide and four (4) inches deep and shall consist of crushed stone or other similar material typically used for this purpose in the local geographical area. Material used shall not contain particles larger than 3/4" in diameter. The top surface of the finished walkway shall be 1/2" to 1" above grade.

5-2-3.7.2 Gravel surfaces.- All areas specified in the CSER to be surface treated around the Azimuth, Elevation, Back Azimuth and DME/P enclosures, shall receive a soil sterilization treatment in accordance with FAA Order 6940.2 and the uniform application of 4 inches of gravel, crushed stone or other similar material typically used for this purpose in the geographical area. Soil sterilization should be limited to areas specifically stated in the CSER.

5-2-3.8 Installation of cables.- The Contractor shall furnish and install all cabling (power, control, facility synchronization and coaxial) between the weatherproof enclosures and associated antennas, (transmitting and monitoring), per the requirements of the CSER and paragraph 3.2.4 of FAA-STD-019. Installation of underground cables shall be in accordance with the requirements of FAA-C-1391. All underground power cables shall be armor-sheathed. If splicing of cables is necessary, as specified in the CSER, it shall be performed in accordance with FAA-C-1391. When local site conditions dictate installations other than in accordance with FAA-C-1391, cable installations shall be accomplished as detailed in the approved CSER. All splice locations shall be indicated on the site specific drawings submitted with the CSER, (paragraph 5-1-3.5.5). At the enclosures, the power shall be installed by direct burial or in conduit, or as required by the CSER. The Contractor shall provide appropriate shielding of cables to prevent electrostatic buildups which may affect proper MLS operation. The Contractor shall also be responsible for furnishing the cabling between the Azimuth, Elevation and DME/P equipments and the RCSU and RSU's unless existing cables can be used as specified in the CSER.

5-2-3.8.1 Fiber optics circuits.-

(a) Optical cable ways, conduit, or cable paths, (e.g., direct burial), shall not be designed nor shall existing facilities be used where the individual bend or cumulative bends, or tension tolerances for the selected cables will be exceeded either during or after installation.

(b) Splice or amplification boxes, where required, shall provide environmental protection and be accessible for inspection and maintenance under all environmental conditions. Enough extra cable shall be provided within the box for at least two extra splices or connections.

(c) The Installation of Fiber Optic Cables shall be in accordance with paragraphs 3.2.2.1 and 3.3.1.4 of FAA-E-2721B.

5-2-3.9 Primary power and lightning protection, grounding, bonding and shielding requirements

5-2-3.9.1 General requirements (Electrical).- The Contractor shall be responsible for extending power to the AZ, DME/P, EL, BAZ and REU/RCSU/RSU locations. The Contractor shall be responsible for all design coordination with the local power company and for furnishing and installing a termination pole and/ord meter pole including associated hardware. The installation shall be in accordance with Drawing SO-D-1573-E15. Additionally, at some locations, a terminal pole may not be furnished or required, but unique electrical hardware such as disconnect switches, fused disconnect panels, electrical surge protectors, and lightning protection devices, etc., will be required to effect extension of the commercial power service by the Contractor. When so required, the equipment used and the installation thereof shall be as specified by the CSER. The Contractor shall procure and install all power cables, transformers, and other material required to provide 120/240 volt AC commercial power to the Azimuth/DME, Back Azimuth, and Elevation facilities. The power cable installations shall be underground and comply with paragraph 5-2-3.8. All electrical services shall be provided by the Contractor to conform to the National Electrical Code, FAA-STD-019, FAA-STD-020, FAA-C-1217, and local, state and city requirements. The Contractor shall provide transformers in accordance with ANSI-C57.12.25. Lightning protection shall be provided with all incoming power service. All non-recurring (construction/connection) and power usage costs, prior to the Government Final Acceptance, will be borne by the Contractor.

5-2-3.9.2 Power installation.- Concrete pads shall be constructed in accordance with drawings contained in the CSER. The locations and sizes of the transformers required shall be shown on the applicable site drawings. When a transformer is located at the facility site, the power cable shall be routed underground from the transformer pad to the equipment shelter and terminated in the power distribution panel. If the transformer is located at a remote point from the site, the power cable shall approach the site underground and enter the shelter through galvanized steel conduit, sweep ells and risers, as necessary. The armor shall be stripped from the cable and properly grounded in the cable junction box or as specified in the CSER.

5-2-3.9.3 Lightning protection, grounding, bonding, and shielding requirements.- Lightning protection, grounding, bonding and shielding considerations as specified by FAA-STD-019 shall be an integral part of the power installation defined in paragraph 5-2-3.9.2.

5-2-3.10 Roads and Parking construction.- The Contractor shall construct service roads in accordance with FAA Order 6940.2 and FAA Drawings D-5980-1 and D-5980-2 at the locations approved in the CSER by the Government. Where local site conditions dictate the use of other construction techniques, work shall be accomplished in accordance as detailed in the approved CSER.

5-2-3.10.1 Paved surfaces.- When it is required that the facility access road intersect or terminate at paved runways, taxiways or other active paved airport surfaces, the driveway and parking area shall be asphalt-paved. Also, should the MLS road combine with an existing road to form a road system less than 300 feet in length and intersecting a paved airport surface, the MLS road segment shall be asphalt paved.

5-2-3.10.2 Parking area.- The parking area for each MLS station shall be constructed in accordance with the CSER. It shall slope away from buildings or equipment support structures at a minimum pitch of one-quarter inch per foot. Ditches adjacent to parking areas shall have side slopes of four to one unless otherwise directed. Concrete curbing, expansion joints and drainage ducts shall be furnished and placed as required.

5-2-3.10.3 Clearing, grubbing and grading.- Clearing, grubbing, and grading for driveways and parking areas shall be accomplished in accordance with Section 2-1 of FAA-C-2454. Clearing limits shall be for a 12 or 14 foot roadway plus 2 foot shoulders and ditch sections as specified in the CSER. Clearing limits for the parking and plot areas shall be a minimum of 2 feet around the perimeters of the area.

5-2-3.10.4 Excavation and grading.- The roadways and parking areas shall be excavated and graded to the elevations shown on the site drawings and shall not deviate from the proposed grade by more than one-tenth foot.

5-2-3.10.5 Culverts.- Culverts shall be provided and installed at the locations indicated on the CSER. Backfill around culverts shall be well compacted in layers of not more than six (6) inches. Unless otherwise specified, there shall be a minimum of one (1) foot cover over all culverts. Culverts shall be of the size shown on the site engineering drawings and shall have flared ends.

5-2-3.10.5.1 Materials.- Culverts shall be constructed from asphaltic coated corrugated, galvanized sheet metal pipe and shall conform to the requirements of Federal Specification QQ-C-806 and AASHO Standard M-36-60.

5-2-3.10.6 Guard posts.- Guard posts shall be provided and installed at culvert locations, parking areas and other locations as shown on the CSER. The guard posts shall be in accordance with Drawing D-5980-2 except that guard posts may be pressure treated wooden posts with metal caps on the top, 4 inches by 4 inches, (surface 4 sides), or larger.

5-2-3.10.7 Reflector posts.- Reflector support posts with reflectors installed thereon shall be provided and installed at the locations indicated on the CSER. The reflector posts shall be in accordance with Drawing D-5980-2.

5-2-3.11 Fences.- Fences shall be provided as indicated on the CSER. All fences and personnel gates shall be Type I, Class F steel chain link fence with three (3) strands of barbed wire in accordance with specification FAA-E-2065 and Drawing D-5597.

5-2-3.12 Site inspection.- Prior to proceeding with installation, tune-up and preliminary checks, (Section 3 of this document), the Contractor shall demonstrate to the satisfaction of the Government, compliance with the Contractor's Site Engineering Report approved by Government as it relates to the site preparation and plant construction, and also with all the paragraphs of Section 2 of this document. Notice of readiness for site inspection must be provided to the COR five days prior to the scheduled date for inspection.

5-2-3.13 Survey points. All survey points required for use with the Portable MLS Receiver shall have a permanent marking. The survey points shall include a point on the foundation of the evaluation antenna foundation. For those points on a hard surface, (i.e. runway or taxiway), this requirement can be satisfied by a clearly visible and identifiable painted symbol. For those points not on a hard surface this can be satisfied with an identifiable concrete monument. The top of this monument shall be no more than 1.5 inches above ground level. The top of the monument shall be a minimum 1' x 1'. The top shall be painted avia- tion orange with paint compatible with freshly cast concrete. Soil sterilizer and gravel surfacing shall be placed in a 4' diameter around the monument, installed per paragraph 5-2-3.7.1, Walkways. Accuracies shall be as specified in Table II. Survey reference markers for the survey points shall be shown on the "As-Built" drawings furnished under Section 5-1 of these specifications.

5-2-3.14 Protection of Existing Cables and Utilities.- It shall be the Contractor's responsibility to locate and protect all functioning utilities from damage and to take the necessary precautions to avoid injuries to a person and the public as a result of this work. All information, namely drawings, plans, sketches and specifications, furnished by the Government, which purports to show the location of existing pipes, ducts, or cables, etc., will be compiled from the best available sources. However, the furnishing of such information on the part of the Government is not to be construed as limiting in any way the sole responsibility of the Contractor for verifying, through actual field investigation or otherwise, the exact location of the said existing pipes, ducts, or cables, etc. To this end, the Contractor may use whatever means necessary in locating the existing utilities, including hand digging instead of machine trenching. In any event, however, any destruction of, or damage to, existing functioning utilities of facilities above or below ground shall be promptly repaired or replaced by the Contractor at his expense in a manner which will meet the specifications of the Government or local utility company where applicable.

Prior to doing any work in the vicinity of the existing public utility installations, (gas lines, water lines, powerline, telephone line, etc.), the Contractor shall be required to contact representatives of the respective utility involved for verification of the exact location of utility and specific safeguard requirements.

5-2-4 QUALITY ASSURANCE PROVISIONS

5-2-4.1 General.- The Contractor shall provide and maintain a quality control system in accordance with the contract requirements, and shall apply the quality assurance provisions as specified in FAA-C-2454. The objective of these quality control systems and programs shall include, but not be limited to, the validation of signal format, RF characteristics, accuracy and coverage requirements as detailed in this specification and in FAA-STD-022.

Each installation shall be tested in accordance with the test plans and procedures, reference paragraph 5-1-3.1.7. The following information shall be prepared for the acceptance team upon completing all site preparation and construction testing.

(a) Data sheets showing the actual measurements made during the Site Preparation and Construction Tests, and the acceptance limits or criteria for each measurement.

(b) A list of all items or parts used during site preparation and construction testing.

(c) A list of equipment installed and tested at each location including all serial numbers and model numbers.

5-2-4.2 Acceptance data.- After acceptance of the site preparation and construction, the data shall be compiled into a report to record Site Preparation and Construction test results for each Construction site.

5-2-5 PREPARATION FOR DELIVERY

5-2-5.1 Not applicable

5-2-6 NOTES

5-2-6.1 None

(Intentionally left blank)

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

SPECIFICATION

MICROWAVE LANDING SYSTEM EQUIPMENT TURNKEY FACILITY ESTABLISHMENT

Section 3

INSTALLATION, TUNE-UP AND PRELIMINARY CHECKS

(Note: This is Section 3 of three Sections in FAA-E-2721/15, Microwave Landing System Equipment, Turnkey Facility Establishment.)

Listing of Sections

(Intentionally left blank)

5-3-1 SCOPE AND SPECIFICATION

5-3-1.1 Scope.- Section 3 is one of three sections of FAA-E-2721/15 Microwave Landing System Equipment, Turnkey Facility Establishment. Section 3 contains the requirements and criteria for the installation and tune-up of a Microwave Landing System. This section supplements the General Requirements contained in Section 1 of this specification. Any additional equipment furnished by the Contractor not specifically identified herein shall nevertheless be the Contractor's responsibility to install and tune-up under this specification.

5-3-1.2 Classification.- The Government will specify in the contract the type of MLS equipment to be installed at each location.

5-3-2 APPLICABLE DOCUMENTS

5-3-2.1 FAA Documents.- The following FAA documents, of the issue specified in the request for proposal, form part of this specification and are applicable to the extent specified herein:

FAA-STD-016	Quality Control System Requirements
FAA-STD-022	Microwave Landing Systems (MLS) Interoperability and Performance Requirements
FAA-G-2100	Electronic Equipment, General Requirements
FAA Order 2500.36	Application of Reimbursable Flight Hour Rates

5-3-2.2 Other Documents

(a) Equipment Instruction Books

(b) Contractor's Site Engineering Report (CSER)

(c) RTCA/DO-177 Minimum Operational Performance Standards for Microwave Landing System (MLS) Airborne Receiving Equipment, (dated July, 1981).

(d) RTCA/DO-189 Minimum Operational Performance. Standards for Airborne Distance Measuring Equipment (DME) Operating within the frequency range of 960-1215 MHz.

5-3-2.3 Military and Federal Publications

5-3-2.3.1 Military Standards and Handbooks

5-3-3 GENERAL REQUIREMENTS

5-3-3.1 Requirements.- The Contractor shall provide all labor, material and tools necessary to accomplish the installation, tune-up, ground check, preliminary flight check, commissioning flight check support, and facility data of the Microwave Landing System.

5-3-3.1.1 Equipment instruction books.- The equipment instruction books referred to in the following subparagraphs shall be distributed with the electronic equipment. The final instruction books will be printed by the Government, with sufficient quantities shipped to the Contractor for distribution with the equipment. If final instruction books are not available at the time the equipment is delivered, the Contractor shall furnish one set of preliminary instruction books with each equipment.

5-3-3.2 Azimuth Station

5-3-3.2.1 Electronic equipment.- The Azimuth and DME/P electronic equipment (including all antennas and field monitors) shall be installed, tuned, and adjusted in accordance with the applicable equipment instruction books, and CSER.

5-3-3.2.2 Ground checking.- The Contractor with COR observing shall perform all ground tests necessary to determine that the Azimuth and DME/P equipment is tuned for optimum operation and that the performance (including the Back Azimuth Function) is within the prescribed tolerances set forth in the equipment instruction books. The Contractor shall perform all preliminary checks, including monitor adjustments prior to Joint Installation Inspection (JII) and Government Commissioning Flight Inspection (GCFI).

5-3-3.3 Elevation Station

5-3-3.3.1 Electronic equipment.- The electronic equipment of the Elevation Station, (including all antennas and field monitors), shall be installed, tuned, and adjusted in accordance with the applicable equipment instruction books, and CSER.

5-3-3.3.2 Ground checking.- The Contractor with COR observing shall perform all tests necessary to determine that the elevation facility equipment is tuned for optimum operation and that performance is within the prescribed tolerances set forth in the equipment instruction books. The Contractor shall perform all preliminary checks, including monitor adjustments prior to the Joint Installation Inspection and Government Commissioning Flight Inspection.

5-3-3.4 Control and Status Equipment. The Contractor shall install the RCSU, RSU's and RCSU Electronics Unit in accordance with the applicable equipment instruction books and CSER.

5-3-3.5 (Not used)

5-3-3.6 Joint Installation Inspection (JII).- The Contractor shall ascertain the satisfaction of the COR that the entire installation is complete, units are properly installed, the equipment is new and facility performance parameters are within initial tolerances stated in the applicable instruction books prior to requesting the Government Acceptance Inspection. The contractor shall also demonstrate that all spare LRU's are operable.

5-3-3.7 Clean-up.- After the Joint Installation Inspection and prior to Preliminary Flight Inspection the Contractor shall be responsible for removing from the sites all surplus material such as tools, equipment, etc., belonging to him, and to clean up rubbish and debris resulting from the work. The Contractor shall fill all excavations, distribute or remove, to a location arranged by the Contractor, all excavated material and repair or restore any items damaged as a result of work and shall leave the premises in a neat and workman-like appearance. Upon completion of "clean-up" operation, the Contractor shall obtain a written release from the airport authority or COR that the sites have been restored to a satisfactory condition.

5-3-3.8 Preliminary Flight Inspection (PFI).- The Contractor shall perform a Preliminary Flight Inspection prior to the Government Commissioning Flight Inspection. The Contractor shall conduct all tests necessary to ensure that the MLS produces a proper signal throughout the coverage sector and that no improper signals are received outside of the coverage sector. Typical flight profiles to be flown are described in Table I. The MLS evaluation and data collection system shall use an MLS airborne receiver which meets RTCA DO-177 Electrical Output "B" standards, while the ground tracker used shall have an accuracy sufficient to demonstrate compliance with the standard set forth in FAA-STD-022. The DME/P interrogator shall meet the Minimum Operational Performance Standards for Precision Distance Measuring Equipment (DME) RTCA/DO-189. The Contractor shall provide calibration data for the tracker.

5-3-3.9 Government Acceptance Inspection (GAI)

5-3-3.9.1 Government inspection.- The Contractor shall notify the Government MLS Program Manager and the COR fifteen (15) days prior to the time that he is ready for the Government Acceptance Inspection. During this inspection, the Contractor shall demonstrate to the inspection team that the facilities listed in FAA-E-2721B are installed in accordance with the CSER and the Equipment instruction books, and that all parameters are operating within the maintenance standards and tolerances set forth in the handbooks associated with each equipment. The Contractor shall collect all required facility data and ground check measurements for recording on data forms specified in the Equipment instruction books during this inspection.

The Contractor shall correct all discrepancies noted during this inspection prior to the Government Commissioning Flight Inspection.

5-3-3.9.2 Documentation.- The Contractor shall transfer three sets of the documentation packages to the COR at the time of Government Acceptance Inspection (GAI). Each documentation package shall include: instruction books, facility logs; and initial test data on equipments identified in paragraphs 5-3-3.2, 5-3-3.3, and 5-3-3.4. The instruction books shall be updated as necessary to be applicable to all approved changes to the original equipment. Any information not available at the time of GAI shall be provided at the Government Final Acceptance, (paragraph 5-3-3.13).

5-3-3.10 Ground and Flight Inspection Standards.- Compliance with the following requirements shall be demonstrated by either ground checks (paragraph 5-3-3.2.2 and 5-3-3.3.2) or flight inspection (paragraph 5-3-3.8) or both; in FAA-STD-022, paragraphs 3.2.1.2.1.3 (amplitudes only), 3.2.1.2.2.1 (amplitudes only), 3.2.3, 3.4, 3.4.1, 3.5, 3.5.2, 3.5.3, 3.5.4, 3.6 (site peculiar content only), 3.7.2.1 (site peculiar content only), 4.1.2, 4.1.4.3, 4.1.6, 4.2, 4.2.2.1, 4.2.2.2, 4.2.3.2, 4.2.4.1, and 4.3; in FAA-E-2721B paragraphs 3.2.1.1.13, 3.2.1.2.11, 3.2.1.4.3.1.2, and 3.2.1.4.4.1.5. The type of checks proposed to satisfy each requirements shall be submitted by the contractor to the government for approval. The format of the data to be supplied for all ground and flight inspections shall also be approved by the government.

5-3-3.11 Government Commissioning Flight Inspection (GCFI).- The Contractor shall formally request flight inspection services when reasonably certain of success, and after a satisfactory preliminary flight inspection has been performed by the Contractor. The Contractor request for Government Commissioning Flight Inspection shall be submitted at least 30 days prior to the date required. The Government will allocate up to 10 data gathering flight hours for the Government Commissioning Flight Inspection and will assume the costs for these hours. The Contractor shall bear the costs for any additional Government flight hours required due to the failure of the facility to meet the performance tolerances prescribed in FAA-STD-022. Costs for these hours shall be at the rate prescribed in FAA Order 2500.36, "Application of Reimbursable Flight Hour Rates".

5-3-3.12 Stability run.- A continuous 120-hour stability run of the MLS equipment shall be performed after the Preliminary Flight Inspection, (paragraph 5-3-3.8). During this time the equipment shall operate, under normal ambient conditions, within monitoring tolerances and demonstrate stable operation. No equipment malfunction shall occur that causes or should cause, an alarm (integrity, hard or soft), alert or maintenance warning. No adjustments to controls of the equipment shall be made during the test period. The Contractor shall be responsible for the equipment during the test. In the event that a monitor alarm occurs that is not directly attributable to equip- ment failure, (unknown causes will be considered equipment failures), or malfunction, the test run may be continued to the 120th hour for completion. If the monitor alarm is caused by improper equipment, installation, equipment failure, malfunction, or maladjustment, the test will restart at the zero hour following the required corrective action. The FAA will be responsible for the monitoring of all alarms, alerts and maintenance warnings and restricting contractor access to the equipment during the stability run. Failures which require a restoration flight inspection, as specified in the manufacturer's instruction books, shall be corrected and the system and/or equipment shall be flight inspected again by the Contractor at no additional cost to the Government prior to restarting the stability run. Determination of the reason for failure will be made jointly by the Contractor and the COR.

5-3-3.13 Government Final Acceptance.- Government Final Acceptance of the complete "Turnkey Facility" shall be made following satisfactory completion of the Government Commissioning Flight Inspection, (paragraph 5-3-3), and the facility clean-up (paragraph 5-3-3.7). The Contractor shall transfer all spare parts to the Government at this time. If this equipment is used in the Reliability Demonstration Program, the Government Final Acceptance shall be made after reliability requirements of the contract have been satisfied.

5-3-3.14 Final "As-Built" drawing submittal.- After the installation of the MLS is complete, all drawing originals shall be revised to reflect the current "As-Built" condition. This revision process applies to all site specific Contractor generated drawings and Government facility drawings that were "red-lined" during installation, and also to any MLS standard drawings that were site-adapted during installation and are no longer standard. These standard drawings shall be revised with the appropriate regional title block and facility title.

The final report shall contain reproducible copies of all site specific drawings and Government facility drawings. These reproducible copies can be either aperture cards in accordance with FAA-STD-023 or "D" size vellum as specified by the particular regional Government office.

5-3-4 QUALITY ASSURANCE PROVISIONS

5-3-4.1 General.- The Contractor shall provide and maintain a quality control system in accordance with contract requirements, and shall apply the quality assurance provisions as specified in Section 4 of FAA-G-2100. The Contractor shall also provide and maintain a software quality program in accordance with contract requirements. The objective of these quality control systems and programs shall include, but not be limited to, the validation of signal format, RF characteristics, accuracy and coverage requirements as detailed in this specification and in FAA-STD-022.

Each installation shall be tested in accordance with the test plans and procedures, reference paragraph 5-1-3.1.7. The following information shall be prepared for the acceptance team upon completing all installation testing on all MLS equipment installed at each location:

(a) Data sheets showing the actual measurements made during the Site Inspection Tests, Stability Run and Preliminary Flight Check, and the acceptance limits or criteria for each measurement.

(b) A list of all items or parts used during installation testing.

(c) A list of MLS equipment, including all serial numbers and model numbers, installed and tested and contractor furnished test equipment at each location.

5-3-4.2 Acceptance data.- After acceptance of the installation, the data shall be compiled into a report to record installation test results for each MLS system installed.

5-3-5 PREPARATION FOR DELIVERY

5-3-5.1 Not applicable

5-3-6 NOTES

5-3-6.1 None

Table I

MINIMUM PRELIMINARY FLIGHT CHECK PROFILES

1. Partial Orbits. - These orbits shall be initiated from one azimuth limit and terminated at the other (e.g. ±40° or ±60°) (1).

Run #	Elevation Angle (4)	Distance from Datum Point
1	0.9°	10 nmi
2	2.0°	10 nmi
3	3.0°	10 nmi
4	5.0°	10 nmi
5	6.0°	10 nmi
6	0.9°	20 nmi Tx power reduced to limit
7	2000 ft.	20 nmi Tx power reduced to limit

2. Radial Flights.- These level runs shall be inbound from 20 nmi and be terminated at the 15° elevation angle (1).

Run #	Azimuth angle (3)(5)	Altitude
1,2	±40°	2,000 ft
3,4	±20°	2,000 ft
5,6	±10°	2,000 ft
7	0°	2,000 ft
(2) 8,9	±60°	2,000 ft

3. Centerline Approaches.-These runs shall be inbound from 20 nmi and be terminated at the datum point.

Run #	Azimuth Angle (3)	Elevation Angle (4)
1	0°	Minimum glidepath
2	0°	0.75 times minimum glidepath
3	0°	1.25 times minimum glidepath
4	0°	6° (if different from above)

4. Full Orbit: These orbits shall be initiated at any convenient azimuth angle and flown a minimum 360°. These orbits shall be at an elevation angle of 0.9° and 5.0° and a range of 10 nmi from the datum point (5). This orbit shall be at an elevation angle of 5.0° and a range of 20 nmi from the datum point (5).

5. Centerline Approach: The ground station alignment shall be shifted to one alignment alarm limit and the airborne receiver shall measure the resultant PFE. The alignment shall be checked at both alignment alarm limits.

Azimuth angle	Altitude
0°, Minimum Glide Path	5 nmi or greater

6. Approach Procedures.- Three runs shall be made at all azimuth radials and glidepaths that form a part of a published approach procedure.

7. Out-of-coverage flight check profiles.- These flight checks shall be conducted to demonstrate compliance with paragraph 4.1.6 of FAA-STD-022. Determination of specific profiles shall be based on site survey data.

NOTES:
(1) Use of Substitute Preliminary Flight Check Profiles: Where obstructions prevent flying along the specified profiles, alternate profiles shall be proposed by the Contractor for approval.
(2) These 2 runs shall be required only for ±60° scanning arrays.
(3) Azimuth angles are relative to the azimuth antenna.
(4) Elevation angles are relative to the elevation antenna.
(5) Where a specified Azimuth radial coincides with the limit of coverage, and therefore unflyable, the nearest flyable radial may be substituted in its place.

Table II

SURVEY REQUIREMENTS

1. Runway length and width to nearest foot. Location of displaced threshold and distance to nearest foot from beginning of runway surface. Runway profile including elevation of runway ends and displaced thresholds, high and low points, grade changes and gradients, and highest elevation within the first 3,000 feet of the runway landing surface. Also field elevation (highest point of any airport landing surface). All elevations shall be referenced to mean sea level (MSL) with a vertical accuracy of one foot. All elevation values shall be computed to one tenth of a foot.

2. Coordinates (latitude and longitude) and MSL of the following positions:

   (a) Both runway ends at centerline of runway.

   (b) Azimuth scanning beam, Elevation scanning beam, and DME/P antennas.
   Reference location shall be the antenna phase center projected onto the radome surface.

   The phase center shall be marked on the front of the antenna enclosure/randome. The elevation station phase center shall also be marked at a point on all sides of the enclosure.

   (c) Airport Reference Point (ARP).

   Coordinates shall be reported in degrees, minutes, seconds, and hundreths of seconds and shall have a horizontal geodetic accuracy of $\pm$1 foot. MSL altitude shall be reported to nearest one tenth of a foot and shall have a vertical geodetic accuracy of $\pm$.1 foot.

3. Relative positions of Azimuth scanning beam, Elevation scanning beam, and DME/P antennas, MLS Datum Point, MLS survey points, and both runway ends at centerline. Relative distances shall have a horizontal and vertical accuracy of $\pm$0.1 foot.

4. Relative position shall be established between a marked survey point on the foundation of the field monitor and the elevation station antenna phase center with a vertical accuracy of +/- 0.03 foot. The phase center of the monitor antenna shall be marked on the front of the enclosure/randome.